Unstructured Mesh Movement and Viscous Mesh Generation for CFD-Based Design Optimization, Phase II

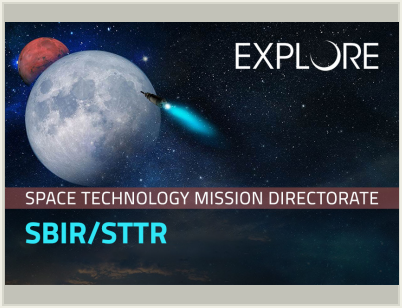
Completed Technology Project (2005 - 2007)

Project Introduction

The innovations proposed are twofold: 1) a robust unstructured mesh movement method able to handle isotropic (Euler), anisotropic (viscous), mixed element (hybrid) and generalized polyhedral unstructured grids for CFD applications, particularly, CFD-based design optimization, and 2) a robust method to automatically insert high quality anisotropic prismatic (viscous boundary layer) cells into any existing CFD mesh. All objectives in Phase I were met and all tasks were completed as proposed. The methods worked very well for both 2D and 3D geometries, for tetrahedral, hexahedral, and general polyhedral element types, and for the simple viscous meshes. In Phase II, we will extend the software into a general purpose package for use by NASA, other Government agencies, and commercial customers. We will implement our 3D viscous mesh generation method including a general solution-adaptive meshing capability. We will develop the software necessary to compute sensitivity derivatives of the mesh operations. Two important software design goals for our final Phase II software are ease-of-use and convenient access to its functionality. We will develop two types of user interfaces: graphical access (for the end-user) and programming access (for integration with flow solvers). We will assemble all of the methods developed in Phase II into a single, coherent, design-oriented, product-version code with extensive focus on incorporating a parallel processing capability into the software. The verification & validation plan will follow the industry-standard approach now used by commercial software houses and will include an extensive set of NASA-relevant test cases. The software will be documented and delivered to NASA. The Phase II software has significant potential for commercialization and sales in the non-Government sector.

Anticipated Benefits

Potential NASA Commercial Applications: The following are some of the many Non-NASA commercial applications for the generalized meshing software. (1) pollution dispersion from stacks of industrial processing plants, (2) design of viscous mixing processes for chemical manufacturing companies, (3) computation of exhaust flow from automobile and bus exhaust systems, (4) design of more efficient internal combustion engines, (5) commercial airplane design for improved fuel economy (6) analysis and design of waste disposal systems, (7) design of air conditioning systems for large buildings, (8) air quality modeling for large-city streets.



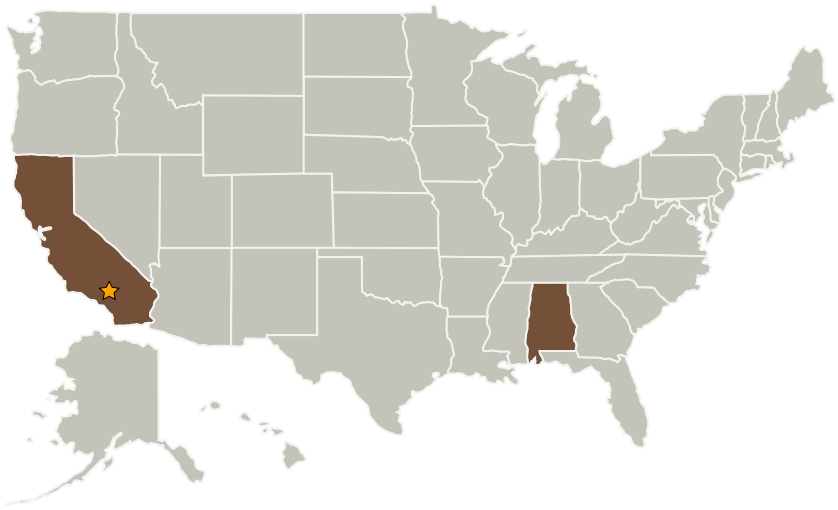
Unstructured Mesh Movement and Viscous Mesh Generation for CFD-Based Design Optimization, Phase II

Table of Contents

Unstructured Mesh Movement and Viscous Mesh Generation for CFD-Based Design Optimization, Phase II

Completed Technology Project (2005 - 2007)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Research South, Inc.	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Lawrence Spradley

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.5 Thermal Control Analysis